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Gender differences in metacognitive skills. A study of the 8th grade pupils in Romania

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Abstract

Prior research has shown inconsistent results regarding the differences on metacognitive skills between boys and girls. Some research suggest that there are differences regarding boys and girls' metacognitive skills, while others suggest that these differences are not significant. However, steady research is needed regarding this subject since the findings of such studies could be used in educational practice. The purpose of this paper is to investigate the potential gender differences regarding the metacognitive skills of 8th graders. 91 pupils from three schools in Romania were assessed on their metacognitive skills, using the Junior Metacognitive Awareness Inventory. The findings indicate that generally both girls and boys use their metacognitive skills in learning. In addition, the results indicate that there are significant differences between boys and girls solely on the following dimensions: the perception of performance as a result of one's will and effort, the perceptions regarding teachers expectations about learning, the use of prior knowledge in problem-solving, planning, knowledge about one's own intellectual strengths and weaknesses, the use of various learning strategies and monitoring the learning process. The results are discussed in relation with implications for future research and educational practice. Further, we emphasize the implications of using self-evaluation methods for assessing metacognitive and self-regulation skills.

Keywords: metacognitive knowledge, cognition and self-regulation, gender, eighth grade pupils.

1. Introduction

Studies conducted on metacognitive processes have followed two different lines of research. One line has focused on the role of metacognitive processes in the development of children's memory functioning and the other has emphasized the role of monitoring one's own knowledge in the learning process. Developmental research emphasizes the expansion of various metacognitive abilities during aging, the effects of these abilities on memory functioning and the learning and remembering strategies that students use in learning. The second line of research brings up the basic mechanisms and processes involved in memory monitoring and control, setting up several experimental paradigms that can guide the study of different basic processes in metacognition (Koriat & Shitzer-Reichert, 2002; Mih, 2010; Lai, 2011).

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Even though there are several theoretical perspectives on metacognition and self-regulation, four assumptions describe the majority of these perspectives. Accordingly, most models of metacognition assume that students are active learners who construct their strategies, goals and meaning during the learning process, and that students are actively regulating various elements of cognition, motivation and behaviour. Furthermore, most models of metacognition assume that students regulate their behaviour in order to achieve a specific goal, and that self-regulation is a mediator between the individuals' performance, contextual factors and personal characteristics (Moss, 2007). Pintrich (2000) considers that metacognition involves the ability to actively control a variety of cognitive processes. Though, in order to be able to control one's own learning, students have to focus on several components of metacognition. Flavell (1979) believes that the metacognitive components that underlie the ability to control cognitive processes during learning are: metacognitive knowledge, metacognitive experiences and metacognitive skills. Metacognitive knowledge encompasses knowledge or beliefs about tasks, strategies and goals. Metacognitive experiences comprise the affective experience that accompanies a cognitive process and metacognitive skills involve the voluntary use of specific strategies for controlling cognitive processes (Desoete & Ozsoy, 2009). Brown's (1987) framework of metacognition, which constitutes the base of the present study, covers two important dimensions: knowledge of cognition and regulation of cognition. The first refers to how much a learner understands about his or her memory (declarative, procedural and conditional knowledge), while the second involves activities such as planning, evaluating and monitoring (Spada, Georgiou & Wells, 2010).

The importance of metacognition is given by its role in the learning process. Research indicates that students who are involved in metacognitive and self-regulation training score higher on school tests than students who do not participate in such training (Wilburne, 1997 in Erskine, 2009). These students are more active and independent learners than their peers who weren't explicitly trained in self-regulation skills (Gott, Lesgold & Kane, 1996). Research conducted by Haller, Child and Wilberg (1988) indicates that seventh and eighth grade pupils were the most receptive in metacognitive training, out of a population of students ranging from the second to the eighth grade. Furthermore, Kirkwood (2000) and Leamnson (1999) point out that the academic skills of the traditional first-year college students are typically ineffective, since these students focus on grades rather than on learning, on memorizing rather than on understanding and on extrinsic sources of motivation. Kirkwood and Leamnson's findings and other researches (Darling-Hammond et al. 2003; Fisher, 1998; Glava, 2009; Schraw, 1998) suggest that students should be encouraged and trained in using metacognitive and self-regulation skills. Given the important role of metacognition and self-regulations skills in learning, research has focused on developing programs for increasing these skills (Gama, 2001; Shen & Liu, 2011; White & Frederiksen, 2000; Wong, 2002). Though, many such programs did not consider the potential differences between boys and girls regarding the use of self-regulation skills, and thus did not address such differences.

Research indicates that the self-perception of academic ability in mathematics and science tend to be lower in the case of females, and this tendency appears to reach its highest point during adolescence (Virtanen & Nevgi, 2010). Although there are many studies concerned with gender differences in metacognition and self-regulation skills, the findings are unsettled. Niemivirta (1997) reported that male students use more superficial learning strategies than females and Bidjerano (2005) indicated that girls use much more often than boys self-monitoring, goal setting and planning. Nonetheless, Zimermann and Martinez-Pons (1990), and recently Zhu (2007) reported that there are no significant differences between boys and girls regarding mathematics self-efficacy. Considering the inconsistent findings on gender differences in metacognitive skills, the present study aims to identify the links between metacognition regulation and gender, in a sample of Romanian middle school students. The study focuses on two essential elements of metacognitive regulation: knowledge of cognition and regulation of cognition.

2. Method

2.1 Participants

The participants (N=90) were junior middle school students in the 8th grade class, from 3 schools in Cluj, Romania. The schools were all from urban area, with the majority of pupils coming from families with middle socio-economic status (assessed through the educational level of parents). Girls were slightly underrepresented in the study considering that 38.9 percent of the participants were girls and 61.1 percent were boys. The mean age of pupils was 14.62 (SD = 0.57). Pupils' distribution by age and sex is represented in Table 1.

		Age			*Total*
		14	15	16	
Sex	Male	17	17	1	35
	Female	21	31	3	55
Total		38	48	4	90

Table 1: Pupils' distribution by age and sex

2.2 Measures and procedure

The Jr MAI scale was completed by participants during the school hours, in a paper and pencil session. The school access was facilitated by secondary school teachers. The participants were informed about the confidentiality of their responses, filled in the questionnaires on a voluntary basis, and were not offer rewards for their participation in the research. The Junior Metacognitive Awareness Inventory (Jr. MAI) includes two scales: Knowledge of cognition and Regulation of cognition. The first scale measures the awareness of one's strengths and weaknesses, knowledge about strategies and why and when to use those strategies. Thus, the knowledge of cognition scale measures declarative, procedural and conditional knowledge. The second scale measures knowledge about planning, implementing, monitoring and evaluating strategy use. The Jr MAI inventory consists of 18 statements to which participants respond by marking one of the 5 items of the scale: from 1 ("the statement does not describe me") to 5 ("the statement describes me well"). The reliability indicator (alpha Cronbach) was 0.78, for all 18 items of the inventory.

3. Results

The statistical analysis indicates that pupils use their metacognitive knowledge and strategies when learning. Table 1 illustrates the means and standard deviations for the items of Jr MAI inventory used in the present study. The least used metacognitive strategy seems to be "using schema and pictures for facilitating the learning process", while the most common metacognitve knowledge used by middle school students "realizing when something is understood".

Items	*Mean*	*Std. Deviation*
I realize when I understand something	4.41	1.09
My performance depends on my will and my effort	4.34	1.12
I try to use ways of studying that had been proved to be successful	4.12	1.30
I know that teachers expect me to learn	4.46	.98
I can learn more about a subject on which I have previous knowledge	3.91	1.43
I make pictures and schema that help me learn better	2.56	1.58
After I finish my work I wonder whether I have learned everything I've wanted	3.08	1.44
I think of several ways to solve a problem and choose the best one	3.44	1.38
I think about what I need to solve the problem before I answer	3.74	1.32
I find myself pausing regularly to check my understanding	3.53	1.27
I concentrate my attention on the most important information	4.27	.90
I can learn more about a subject on which I have special interest	4.39	1.01
I use my intellectual strengths to compensate for my weaknesses	3.88	1.19
I use different learning strategies depending on the situation	3.11	1.39
I find myself checking if I will finish my work in time	3.47	1.50
I find myself using helpful learning strategies automatically	3.19	1.51
After I finish my work I wonder whether there was an easier way to do it	3.31	1.42
I think about what I need to solve the problem before I answer	3.70	1.39

Table 1. Means, standard deviations and one-sample t test

The *knowledge of cognition scale* includes the following items: "I realize when I understand something", "My performance depends on my will and my effort", "I try to use ways of studying that had been proved to be

successful", "I know what teachers expect me to learn", "I can learn more about a subject on which I have previous knowledge", "I can learn more about a subject on which I have special interest", "I use my intellectual strengths to compensate for my weaknesses", "I use different learning strategies depending on the situation" and "I find myself using helpful learning strategies automatically". As shown in Table 1, the items which compose the knowledge of cognition scale have the means between 3.11 and 4.46, which indicates a high level of metacognitive knowledge. The second scale, *regulation of cognition*, consists of the following items: "I make pictures and schema that help me learn better", "After I finish my work I wonder whether I have learned everything I've wanted", "I think of several ways to solve a problem and choose the best one", "I think about what I need to solve the problem before I answer", "I find myself pausing regularly to check my understanding", "I concentrate my attention on the most important information", "I find myself checking if I'll finish my work in time" and "I think about what I need to solve the problem before I answer". The metacognitve strategies included in the regulation of cognition scale seem to be moderately (mean = 2.56) and highly (mean = 4.27) used by middle school students.

The differences between boys and girls regarding metacognitive skills seem to occur solely for specific metacognitive knowledge and skills. Table 2 shows that these differences occur mainly in the case of items that measure knowledge of cognition. Accordingly, there are significant differences in metacognition between boys and girls on the following metacognitive knowledge: "My performance depends on my will and my effort" ($F = 9.20$ $p<0.01$), "I know what teachers expect me to learn" ($F = 7.91$, $p<0.01$), "I can learn more about a subject on which I have previous knowledge" ($F = 4.87$, $p<0.05$), "I use my intellectual strengths to compensate for my weaknesses" ($F = 9.11$, $p<0.01$) and "I use different learning strategies depending on the situation" ($F = 7.12$, $p<0.01$). The largest difference occurs in the case of internal attribution made for school achievement, which indicates that boys and girls make different internal attribution for performance.

Items	*F*	*P*
I realize when I understand something	.024	.877
My performance depends on my will and my effort	9.207	.003
I try to use ways of studying that had been proved to be successful	.012	.912
I know what teachers expect me to learn	7.917	.006
I can learn more about a subject on which I have previous knowledge	4.879	.030
I make pictures and schema that help me learn better	.089	.766
After I finish my work I wonder whether I have learned everything I've planned to learn	.059	.809
I think of several ways to solve a problem and choose the best one	.000	.999
I think about what I need to solve the problem before I answer	8.583	.004
I find myself pausing regularly to check my understanding	3.345	.071
I concentrate my attention on the most important information	.534	.467
I can learn more about a subject on which I have special interest	.753	.388
I use my intellectual strengths to compensate for my weaknesses	9.116	.003
I use different learning strategies depending on the situation	7.121	.009
I find myself checking if I will finish my work in time	4.233	.043
I find myself using helpful learning strategies automatically	.196	.659
After I finish my work I wonder whether there was an easier way to do it	.088	.767
I think about what I need to solve the problem before I answer	1.538	.218

Grouping Variable: Sex Table 2. Independent Samples Test

Strategies such as monitoring and planning might be used in different ways by girls and boys. Data analysis revealed significant differences between boys and girls on the following two items which measure regulation of cognition: "I think about what I need to solve the problem before I answer" ($F = 8.58$, $p<0.01$) and "I find myself checking if I will finish my work in time" ($F = 4.23$, $p<0.05$). From all nine items that measure regulation of cognition, significant differences were revealed only for the two items mentioned above.

4. Discussions and conclusion

Using Brown's (1987) framework of metacognition, the present study investigated the differences in metacognitive regulation between girls and boys, in a sample of middle school students. Prior research reports inconclusive findings regarding the differences in metacognition according to pupils' gender. For instance, Sperling et al. (2002, cited in Topçu & Yilmaz-Tüzün, 2009) investigated the gender differences in metacognitive skills (knowledge of cognition and regulation of cognition) and revealed insignificant gender differences. Nevertheless, the present study indicates that there are some gender differences in metacognition. The most differences seem to firstly emerge on knowledge of cognition rather than on regulation of cognition. However, some elements of both knowledge and regulation of cognition are differently related to learning according to pupils' gender. It seems that boys and girls use differently their metacognitive knowledge and skills in the learning process.

The study also revealed that the 8th grade pupils who participated in the present research generally use their metacognitive knowledge and skills in learning. This has positive influences upon pupils' learning and school performance since research indicates that metacognition and self-regulation increase academic motivation and learning (Shunk & Ertmer, 2000). Hence, metacognition skills in a specific domain could be used as an indirect assessment of performance.

However, a question arises concerning the measurement of metacognition and self-regulation skills. We could ask if these self-evaluation tools are appropriate for capturing when and how students use them during the learning process. Researches such as Jacobs and Paris (1987) have used the interview as an assessment tool for metacognitive and self-regulated learning. Hence, there are a variety of challenges related to metacognition measurement. MacLeod, Butler and Syer (1996) consider that it is difficult to establish specific goals at the metacognitive level. Even if learning goals could be easily establish at a cognitive level, it is difficult to do the same thing at a metacognitive level. Further, they believe that metacognitive skills should be assessed in learning contexts rather than in testing contexts. MacLeod, Butler and Syer argue that metacognitive skills are sensitive to the assessment contexts, and this feature should be taken into consideration when assessing such skills.

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